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(54) **Replacement part with integral memory for usage and calibration data**

Ersatzteil mit integriertem Speicher für Gebrauchs- und Eichungsdaten

Pièce de rechange à mémoire intégrée pour des données d'utilisation et de calibrage

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Description

[0001] This invention relates to apparatus that employs replaceable, consumable, parts and supplies and, more particularly, to replaceable, consumable parts and supplies that include integral memory for storing both usage and calibration data.

[0002] Substantially all present-day copiers, printers, plotters, etc. include a controlling microprocessor which requires input calibration data for internal components so as to enable high quality production of documents. Since most such apparatus is produced so as to allow user-replacement of consumable items, entry of usage and calibration data must be performed by the user (or repair-person) who is performing the replacement operation. Any error in entry of calibration data can substantially degrade the apparatus or render the apparatus inoperative.

[0003] To determine usage of consumables, the prior art has generally been restricted to simple record-keeping entries which enable the user to know when replacement is required. For instance, copiers often display a count of the number of output pages and maintain an internal record of the number of rotations of the drum (or of an organic photoconductor web) to enable the processor to signal when service or replacement is required.

[0004] Replaceable developer modules are currently employed in many electrophotographic printers and copiers. Each developer module includes a supply of toner and toner carrier along with a mechanism to bring the toner/carrier mixture to a drum (or web) surface. To provide proper control signal levels for a laser exposure system, the control microprocessor adjusts the ratio of toner to carrier so as to achieve a proper mixture. One method for controlling the toner-to-carrier ratio is to provide an oscillator circuit whose frequency is varied by the toner-to-carrier ratio. Upon an initial installation of a new developer module, the control processor takes a number of minutes to accumulate sufficient data from the oscillator circuit to determine the toner-to-carrier ratio so as to enable a setting of the proper signal levels in the laser exposure system. If the developer module is removed from the apparatus or is transferred to another apparatus, the entire calibration procedure must be repeated.

[0005] While, as above indicated, printers and copiers have heretofore retained an output page count, such a raw page count does not take into account different wear levels created by different media types. For instance, a fuser assembly (which includes a pair of platen rollers, one or both being heated) manifests a surface breakdown phenomenon after approximately 80,000 pages of a standard media type. Different media types cause a variation in fuser assembly wear and a simple page count does not account for such variations.

[0006] Fuser assemblies used with color printers employ a silicone oil to increase color saturation level and to provide a glossy finish to printed media sheets. Different media types require variations in the amount of applied oil. A control system is provided to enable the fuser assembly to know the particular type of media sheet so as to enable a determination of the amount of oil to be deposited. While the processor maintains track of cumulative oil usage, if the fuser assembly is removed or the stored data regarding oil usage is lost, there is no way to reconstruct the usage state of the fuser assembly when it is put back into service.

[0007] In a similar fashion, an electrophotographic drum includes a photosensitive layer that manifests a determined charge sensitivity. Such charge sensitivity data is employed as a control parameter in the power control loop of the laser exposure system. Heretofore, such charge sensitivity data has been entered by the operator. If, however, the drum is transferred between printers, as may happen during servicing, such data does not travel with the drum hut must be reentered.

[0008] U.S. Patent 5,049,898 to Arthur et al., assigned to the same assignee as this application, discloses a disposable printing assembly wherein an integral memory element stores data that characterizes the assembly. Arthur et al. provide an ink jet print head assembly with a memory which designates the color of ink in the print head, its amount, and the position of the ink jet orifice plate on the print head body. This data is read from the print head by a read/write element in the printer and is then used or displayed, as desired.

[0009] Many consumable, replacement parts for printers/copiers include a fuse that is integral to the replacement part and identifies whether the replacement part is new or used. If, upon insertion of the replacement part, the controlling microprocessor determines that the fuse is intact, the machine determines that the replacement part is new and zeros out its count values which indicate the remaining usable life for the part. When further input data concerning the replacement part is required, the microprocessor either indicates the need for such data to the user via a control panel or automatically gathers the data from a replacement part sensor (as in the case of the toner-to-carrier ratio in a developer module). Thereafter, the fuse is blown (see e.g. US-A-5,021,828).

[0010] Such a prior art circuit is shown in Fig. 1 for an electrophotographic printer wherein each of a plurality of consumable parts are plug connected to a printer at an interface 10. The plug-connected consumable items include an oil pad module 12, a black (K) toner developer module 14, a color developer module 16, a fuser assembly 18, a transfer assembly 20, and a photographic drum assembly 22. Those skilled in the art will realize that there are other additional consumable items which can also be plug connected to a printer, in addition to the aforementioned consumable parts. Each consumable item includes a fuse 24 that is blown by fuse blow circuitry module 26 upon completion of a calibration action by control computer 28. Fuse 24 is incorporated into the structure of each of the replacement items and is

connected via a single wire to a contact 30 in a multiple contact connector, which interfaces with a connector in the printer. A ground connection 32 within the replacement item enables a complete circuit to be made through fuse 24.

[0011] US-A-5,365,312 relates to an arrangement for printer equipment for monitoring reservoirs that contain the printing medium, wherein the reservoirs comprise an electronic memory means in the form of a chip in which information about the current fill status and/or other status data relevant for the printer operation are stored. Via two lines, the respective chips are connected to a central controller including an application specific integrated circuit used for controlling access to the respective memory chips.

[0012] US-A-5,283,613 concerns a monitoring system for electrophotographic printing machines using replaceable cartridges, wherein each cartridge in the machine is provided with an electronic count memory and an electronic flag memory. The respective memory chips are connected with a control unit via a plurality of lines corresponding to the number of memory elements on the chip.

[0013] US-A-5,218,407 discloses an image-forming apparatus having a E^2PROM to store information such as emptiness of toner and number of image formations. By means of a plurality of lines, the memory is connected to a central processing unit of the image-forming apparatus.

[0014] Starting from this prior art, it is the object of the present invention to provide an improved apparatus for making marks on media sheets which uses a replaceable part/consumable with an integral memory that enables data to be stored and altered without requiring any modification to an existing physical interface between the part/consumable and apparatus in which the part/consumable is placed.

[0015] This object is achieved by an apparatus according to claim 1.

[0016] A printer/copier apparatus is adapted to receive replacement parts that are subject to wear or which comprise a consumable that is employed during the printing/copying operation. The apparatus includes a first connector that is coupled to a processor/memory combination which controls operation of the apparatus. A replaceable part includes a second connector which mates with the first connector. The replaceable part includes a serial access memory that is connected to the second connector by only a single wire. Data transfers are enabled both from and to the serial access memory to allow storage of data that is indicative of usage, calibration, or other data relating to the replaceable part. Usage of the single wire enables direct substitution of the serial access memory in place of a presently provided fuse, without requiring changes to the physical interface between the replaceable part and the connectors which mate the replaceable part with the apparatus.

[0017] Fig. 1 is a block diagram of a prior art apparatus wherein each replaceable part includes an integral fuse that is wired to an interface connector via a single wire.

[0018] Fig. 2 is a block diagram that illustrates the invention.

[0019] Fig. 3 illustrates further detail of an interface portion of a replaceable part, showing a one wire interconnection for an on-board serial access memory.

[0020] Hereafter, the invention will be described in the context of an electrophotographic printer, however it is to be understood that the invention is applicable to any computer-controlled apparatus that includes replaceable parts/consumables.

[0021] As will be understood, the invention enables usage and calibration data to be stored in a single wire memory module that is incorporated into a replaceable part. Thus, if the replaceable part is transferred from first apparatus to second apparatus, the second apparatus is enabled to adjust its control parameters in accordance with the data stored in the part's on-board memory. This is critical when data from the replaceable part must be interrelated with other data to enable derivation of apparatus control signals. For instance, humidity data that is internally sensed within a printer, when combined with a photoconductor's sensitivity data, directly influences the laser's exposure settings. If incorrect photoconductor sensitivity data is utilized, printer performance is adversely affected.

[0022] Recently, single wire access, serial memories have become available in the marketplace. One such memory family comprises the DS1992-DS1995 Touch Memories from Dallas Semi-Conductors Inc. Each of those memories is configured as a nonvolatile, random-access memory with storage sizes which range from 1K - 16K bytes. In the case of the DS1992, the internal 128 bytes of nonvolatile RAM are organized as four storage areas of 32 bytes each and a scratch pad of 32 bytes. Data input and output from the one wire memory is accomplished via a protocol wherein various length pulses are employed which evidence the beginning of a read/write action. Those pulses are followed by bit-by-bit transfers, wherein ones and zeros are manifest by different pulse lengths.

[0023] Referring to Fig. 2, each replaceable part/consumable mates with a receptacle 36 (shown schematically) within a printer 38. Each of the fuses shown in Fig. 1 have been replaced by a memory chip 40 which connects to the preexisting connector 30 via a wire 42 and enables storage of both usage and calibration data regarding the replaceable part. In Fig. 3, a further detailed view is shown of an interface between a replaceable part 50 and a connector 52 within a printer. Replaceable part 50 includes a plurality of sensors A-N that are interconnected with an interface board 54 on which one-wire memory chip 40 and electronics module 56 are mounted. (Most of the interconnections on board 54 are not shown to avoid an overcomplication of the view.) Sensors A-N feed signals to electronics module 56 which provides an interface function to connector 52 and the

various control and sense lines that are connected thereto. Line 42 from one-wire memory chip 40 is connected via contact 32 to memory line 58 which is, in turn, connected to control computer 28 so as to enable both reading and writing actions with respect to memory chip 40.

[0024] In order to enable control computer 28 to identify the particular replaceable part, it is preferred that blocks of serial numbers be preassigned to replaceable part types. Control computer 28 is pre-loaded with appropriate data that enables identification of the particular replaceable part, simply by reading the serial number stored in memory chip 40 carried by the replaceable part.

[0025] During operation of the printer, control computer 28 is periodically activated to cause outputs from sensors A-N to be recorded so as to enable use of the sensed data in rendering system adjustments. In this regard, data from plural memory chips are correlated so as to enable more accurate adjustments than heretofore. For example, as indicated above, fuser assemblies have determined the amount of silicone oil to apply to a media sheet in dependence upon the type of media sheet being fed. Prior art systems have employed a light sensor to detect the reflectivity of the media sheet in order to alter a silicone oil deposition rate. As the silicone oil is contained in a sponge-like media, the fuser assembly rollers are slowed to achieve a greater silicone oil deposition upon selected types of media sheets. Currently, EP printers slow the fuser rollers by approximately 50% when overhead transparencies are fused. This slow down roughly doubles the amount of silicone oil deposited. Through the use of this invention and detailed knowledge of past silicone oil usage - as derived from data stored in a memory chip 40, the temperature of the fuser rollers can be increased to increase the silicone oil release rate to obtain a desired color saturation level - without decreasing the roller speed. Thus, with precise knowledge of past silicone oil usage history, the temperature of fuser rollers can be altered by control computer 28 to allow the fuser system to operate at full speed while the silicone oil is being deposited at the higher temperature.

[0026] In a similar manner, data can be stored in a memory chip 40 which enables more accurate control in response to developer module parameters. Presently, the only information stored by control computer 28 regarding a color developer module is a sensor offset, a page count, and a humidity value. The sensor offset is used to control the toner-to-carrier ratio. Page count is used to also modify the toner-to-carrier ratio to compensate for aging of the developer's mechanical assemblies and aging of the carrier, per se. It will be recalled that the carrier is a magnetic material used to convey toner and helps develop proper electrostatic charges on the toner particles. Memory chip 40 will preferably store additional data regarding developer module parameters that affect image production. Those parameters will include: developer magnet strength; absolute distance between the developer sleeve and the photoconducting drum; developer surface roughness and absolute magnet angle. Each of the aforesaid parameters directly affects development quality and will enable control computer 28, upon determining the aforesaid stored parameters, to more accurately compensate for variations thereof. Similarly, a memory chip 40 associated with a drum would record a parameter defining the drums' photosensitivity (i.e. charge and discharge characteristics). Control computer 28 will compensate for variations in that parameter by adjusting toner carrier ratio, laser power and bias settings for both the developer module and the drum photoconductor.

[0027] Further, carrier particles employed with the toner exhibit a charge-to-mass ratio which is a measure of the carrier's ability to impart a charge to the toner. Such charge-to-mass ratio is recorded after manufacture and a low charge-to-mass ratio means that there is less control of the toner and that it is emplaced more easily on the drum. Such charge-to-mass ratio, as measured by the manufacturer, can be stored in a memory chip 40 attached to each developer module. Upon initialization, a printer would adjust a number of settings in the printer to compensate for a charge-to-mass ratio which falls outside of an expected range (e.g., the toner-to-carrier ratio could be altered, the drum bias setting changed, the laser power setting or the developer bias setting altered etc.).

[0028] Upon receiving updated sensor data and performing the necessary calculations, control computer causes revised usage and/or calibration data to be written to the respective memory chips 40 to update their memory states. Thus, if a replaceable part from a first printer is transferred to a second printer, control computer 28 in the second printer is enabled to access the usage and calibration data of the newly substituted replaceable part and to accurately adjust its operating states in accordance therewith.

Claims

1. Apparatus for making marks on media sheets, said apparatus adapted to receive replaceable parts that are subject to wear or include a consumable that is employed during operation of said apparatus, said apparatus comprising:

   processor means (28) for controlling said apparatus;

   a receptacle (36) for receiving a replaceable part;

   first connector means (52) associated with said one receptacle and coupled to said processor means (28); and

a replaceable part (50), juxtaposed to said receptacle (36) and including a second connector means (30) that mates with said first connector means (52), said replaceable part (50) including a memory (40) that is connected to said second connector means (30), said processor means (28) enabled thereby to both read and write data from and to said memory (40), said memory (40) storing data at least indicative of usage of said replaceable part (50);

characterized in that
said memory (40) is a serial access memory (40) that is connected to said second connector means (30) by only a single wire (42).

2. The apparatus as recited in claim 1 wherein said processor means (28) is controlled to periodically write updated usage data into said serial access memory (40) so as to accurately reflect usage of said replaceable part (50).

3. The apparatus as recited in claim 1, wherein said serial access memory (40) is coupled to a fuser assembly and includes data regarding past usage history of an incorporated silicone oil supply, said processor means (28) responding to said data regarding past usage history to modify a temperature of said fuser assembly upon determining that a transparency media sheet is to pass in contact therewith.

Patentansprüche

1. Vorrichtung zum Erzeugen von Markierungen auf Medienblättern, wobei die Vorrichtung angepaßt ist, um ersetzbare Teile aufzunehmen, die einer Abnutzung ausgesetzt sind oder ein verbrauchbares Gut einschließen, das während des Betriebs der Vorrichtung verwendet wird, wobei die Vorrichtung folgende Merkmale umfaßt:

eine Prozessoreinrichtung (28) zum Steuern der Vorrichtung;

eine Aufnahme (36) zum Aufnehmen des ersetzbaren Teils;

eine erste Verbindereinrichtung (52), die der einen Aufnahme zugeordnet ist und mit der Prozessoreinrichtung (28) verbunden ist; und

ein ersetzbares Teil (50), das benachbart zu der Aufnahme (36) angeordnet ist und eine zweite Verbindereinrichtung (30) einschließt, die mit der ersten Verbindereinrichtung (52) zusammenpaßt, wobei das ersetzbare Teil (50) einen Speicher (40) einschließt, der mit der zweiten Verbindereinrichtung (30) verbunden ist, wobei dadurch ermöglicht wird, daß die Prozessoreinrichtung (28) Daten sowohl von dem Speicher (40) liest als auch in denselben schreibt, wobei der Speicher (40) Daten speichert, die zumindest die Verwendung des ersetzbaren Teils (50) anzeigt;

dadurch gekennzeichnet,
daß der Speicher (40) ein Seriellzugriffsspeicher (40) ist, der mit der zweiten Verbindereinrichtung (30) durch nur einen einzelnen Draht (42) verbunden ist.

2. Die Vorrichtung nach Anspruch 1, bei der die Prozessoreinrichtung (28) gesteuert ist, um periodisch aktualisierte Verwendungsdaten in den Seriellzugriffsspeicher (40) zu schreiben, um so die Verwendung des ersetzbaren Teils genau wiederzugeben.

3. Die Vorrichtung nach Anspruch 1, bei der der Seriellzugriffsspeicher (40) mit einer Verschmelzungsanordnung gekoppelt ist und Daten einschließt, die die vergangene Verwendungsgeschichte einer eingebauten Silikonölversorgung betreffen, wobei die Prozessoreinrichtung (28) auf die Daten betreffend die vergangene Verwendungsgeschichte reagiert, um eine Temperatur der Verschmelzungsanordnung zu modifizieren, wenn bestimmt wird, daß ein transparentes Medienblatt diese in Kontakt mit derselben durchläuft.

Revendications

1. Dispositif pour réaliser des marques sur des feuilles de support, ledit dispositif étant adapté pour recevoir des pièces remplaçables qui sont sujettes à l'usure ou qui comportent un produit consommable utilisé pendant le fonctionnement dudit dispositif, ledit dispositif comprenant :

des moyens formant processeur (28) pour commander ledit dispositif ;
un réceptacle (36) pour recevoir une pièce remplaçable ;
des premiers moyens formant connecteur (52), associés audit réceptacle et couplés auxdits moyens formant processeur (28) ; et
une pièce remplaçable (50), juxtaposée audit réceptacle (36) et comportant des deuxièmes moyens formant connecteur (30) venant s'accoupler avec lesdits premiers moyens formant connecteur (52), ladite pièce remplaçable (50) comportant une mémoire (40) connectée auxdits deuxièmes moyens formant connecteur (30), lesdits moyens formant processeur (28) étant ainsi activés à la fois pour lire et écri-

re des données depuis et vers ladite mémoire (40), ladite mémoire (40) contenant des données au moins indiquant l'utilisation de ladite pièce remplaçable (50) ;

caractérisé en ce que

ladite mémoire (40) est une mémoire à accès en série (40) connectée auxdits deuxièmes moyens formant connecteur (30) seulement par un simple fil (42).

2. Dispositif selon la revendication 1, dans lequel lesdits moyens formant processeur (28) sont commandés pour écrire périodiquement des données d'utilisation mises à jour dans ladite mémoire à accès en série (40), de façon à représenter précisément l'utilisation de ladite pièce remplaçable (50).

3. Dispositif selon la revendication 1, dans lequel ladite mémoire à accès en série (40) est couplée à un ensemble fusible et comporte des données concernant l'historique d'utilisation antérieure d'une alimentation en huile de silicone incorporée, lesdits moyens formant processeur (28) répondant auxdites données concernant l'historique d'utilisation antérieure pour modifier la température dudit ensemble fusible lors de la détermination du fait qu'une feuille de support transparente va venir en contact avec celui-ci.

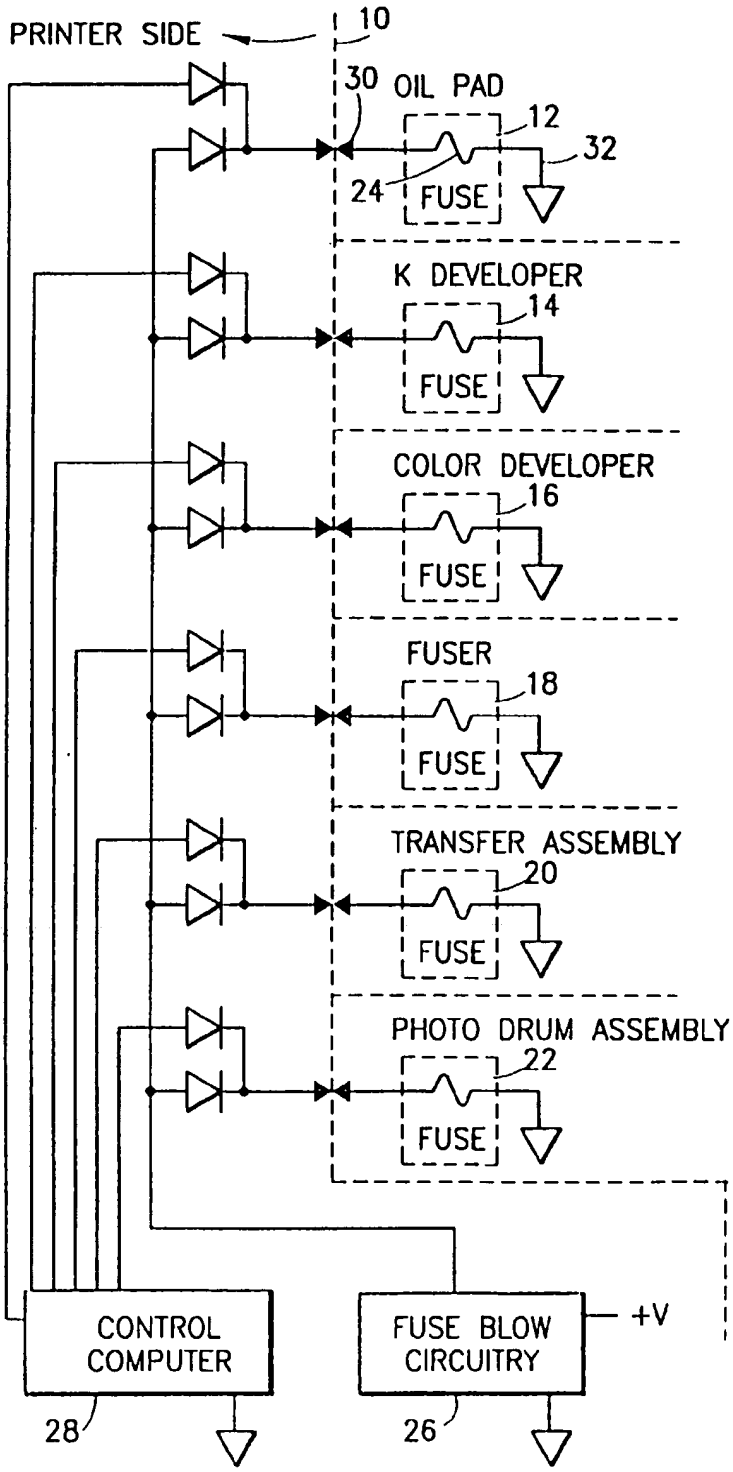

FIG. 1
PRIOR ART

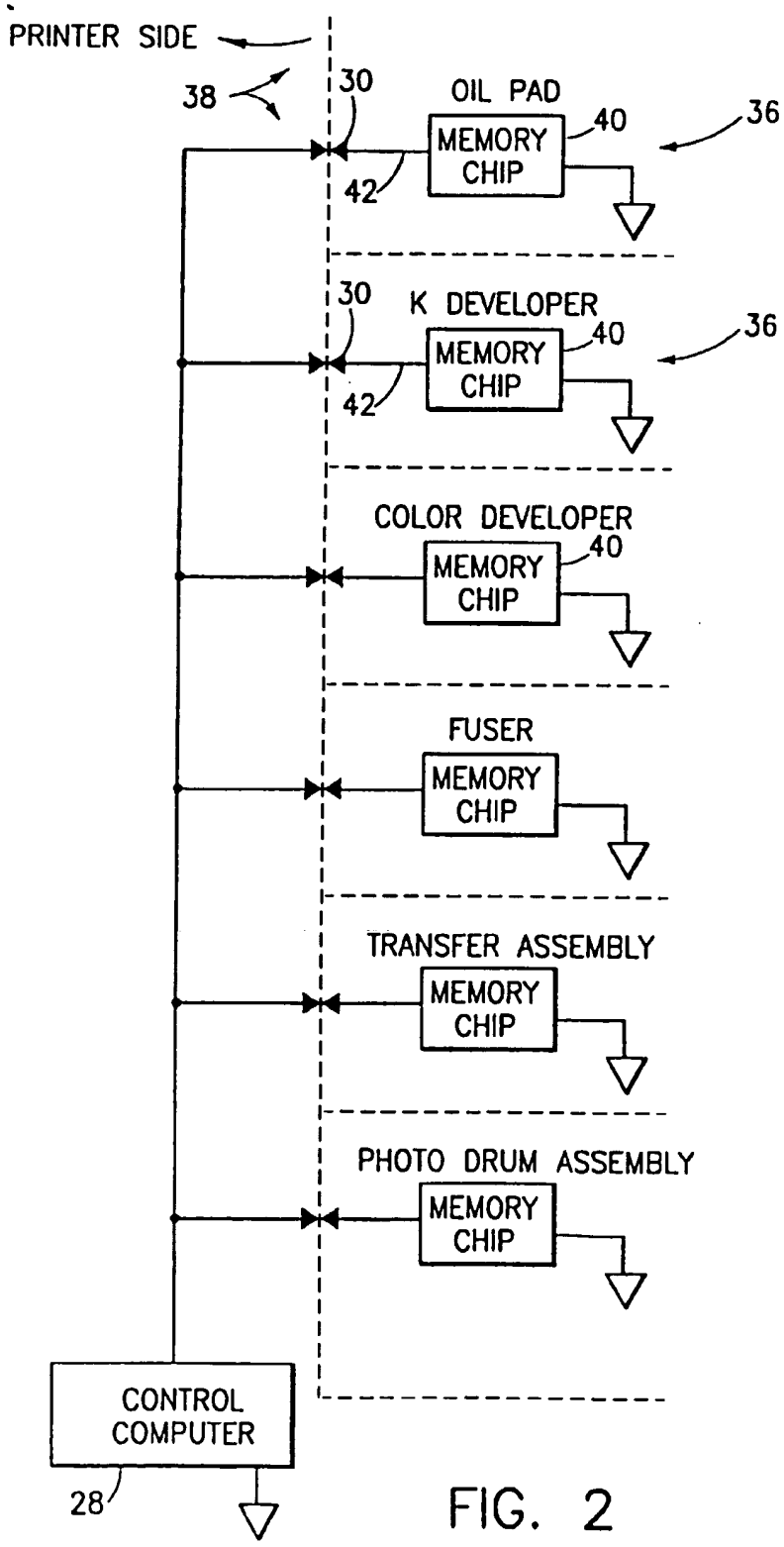
PRINTER SIDE
38
30
OIL PAD
MEMORY CHIP
40
36
42
30
K DEVELOPER
MEMORY CHIP
40
36
42
COLOR DEVELOPER
MEMORY CHIP
40
FUSER
MEMORY CHIP
TRANSFER ASSEMBLY
MEMORY CHIP
PHOTO DRUM ASSEMBLY
MEMORY CHIP
CONTROL COMPUTER
28

FIG. 2

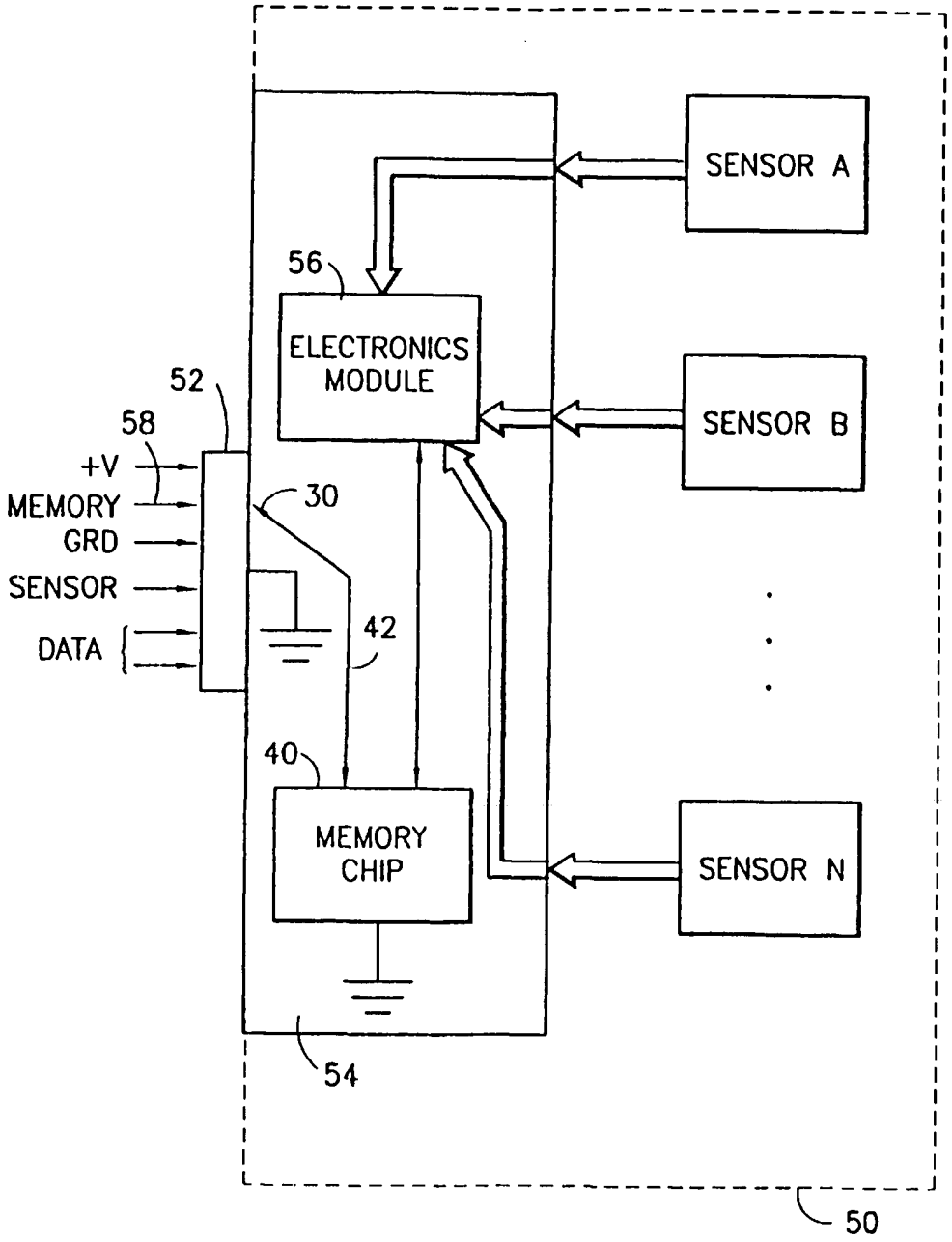
SENSOR A
56
ELECTRONICS MODULE
52
58
SENSOR B
+V
MEMORY
GRD
SENSOR
DATA
30
42
40
MEMORY CHIP
SENSOR N
54
50

FIG. 3